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Aqua MODIS First Year On-orbit Calibration and Performance

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ABSTRACT

The MODerate Resolution Imaging Spectroradiometer (MODIS) Flight Model 1 (FM1) was launched on May 4, 2002 onboard the NASA Earth Observing System (EOS) Aqua spacecraft. It has provided more than a year of global data for studies of the Earth's land, oceans, and atmosphere in support of the science community and public users. To assure the quality of the data and science products, extensive efforts have been made to collect and analyze data on the instrument's on-orbit performance using its on-board calibrators (OBCs). MODIS has 36 spectral bands: 20 reflective solar bands (RSBs) with wavelengths from 0.41 micrometer to 2.2 micrometers and 16 thermal emissive bands (TEBs) from 3.7 to 14.2 micrometers. For radiometry, the RSBs are calibrated by a solar diffuser (SD) and a solar diffuser stability monitor (SDSM) system and the TEBs by a blackbody (BB). An on-board Spectroradiometric Calibration Assembly (SRCA) is used for the instrument's spectral (RSBs only) and spatial (all 36 bands) characterization. Using the first year's calibration data sets, this paper presents Aqua MODIS on-orbit performance in three areas: radiometric, spatial, and spectral. Comparisons with the sensor's specifications and with the performance of its predecessor, Terra MODIS (launched in December 1999), are discussed. Excluding a few problems identified pre-launch, such as non-functional detectors in the 1.6 micrometers band and the out of specification performance for the band to band registration (BBR), the on-orbit observations and analyses show that Aqua MODIS has been performing according to its design characteristics.

Keywords: Aqua, MODIS, solar diffuser, SRCA, blackbody, calibration, radiometry

1. INTRODUCTION

Aqua is one of the major satellite missions of the US National Aeronautics and Space Administration (NASA)'s Earth Observing System (EOS). The Aqua satellite was launched on May 4, 2002. It is a sister of the EOS Terra satellite previously launched on December 18, 1999. Both satellites are operated in a sun-synchronous orbit at an altitude of 705km with the Aqua spacecraft crossing the equator at about 1:30 pm (local time, descending southward) and the Terra spacecraft crossing the equator at 10:30 am (local time, ascending northward). There are five Earth-observing instruments onboard the EOS Terra platform and six onboard the Aqua. The MODerate Resolution Imaging Spectroradiometer (MODIS) is one of the key instruments of the NASA EOS and is currently operating onboard both the Terra and Aqua satellites[1-4].

MODIS is a scanning radiometer with 36 spectral bands that cover wavelengths from 0.41 micrometer to 14.2 micrometers, making measurements at three nadir spatial resolutions: 250m, 500m and 1km. It has a field of view (FOV) of ±55^{o} from the instrument nadir, resulting in a swath of 10km (at nadir) along track by 2330km cross track during each scan of 1.47 seconds. Both Terra and Aqua MODIS are able to provide near global coverage in 2 days. Working together, the two MODIS instruments can view the same Earth scene with complementing morning and afternoon observations, thus providing diurnal information on many of the parameters for the long-term studies of the climate, weather, and environmental changes[3, 5-8]. The Aqua MODIS started its Earth scene observations on June 24, 2002 (aka first light) when the nadir aperture door (NAD) was opened. Except for a few spacecraft safe-hold events during its check out period (launch + 120 days) that resulted in small response changes and minor data gaps, the Aqua MODIS instrument has been operating continuously and producing calibrated data sets for use by the scientific research community.

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